Descriptive Epidemiology of USAF Injuries During Operational Deployment, FY02-FY03

Research and Epidemiology Branch

Lt Col Bruce Copley, PhD, MPH
Lt Col Bruce Burnham, DVM, MPH
Capt Matthew Shim, MA, MPH

July 2004

Introduction

In May 2004, this branch (HQ AFSC/SEPR) was tasked by the Defense Safety Oversight Council's Deployment and Operations Task Force (DOTF) to account for and describe injuries to active duty airmen that occurred during deployment operations. SEPR responded to this tasker, providing the leaders with more data than had previously been available for similar taskings. Over the past couple of years, safety/mishap data from deployed locations--particularly from Southwest Asia (SWA)--has begun to flow through the Air Force Safety Automated System (AFSAS) to the point where we now have sufficient data to describe the circumstances surrounding those events in some detail. AFSAS reporting provides a sufficiently robust sample of all reportable mishaps on which to assess risks and to apply prevention techniques. While some degree of underreporting probably exists, we do not need information on 100% of the mishaps to acquire a reasonable perspective on how mishaps occur. The "big rocks" in deployment mishaps look very similar to those of non-deployment mishaps, thus AFSAS seems to be delivering a realistic picture for further research.

Methods

We ran a query in the AFSAS data warehouse for injury-producing ground mishaps that met our "case definition" for deployment relatedness. The query focused on contingency operations such as Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) rather than expanding the definition to other operational TDY locations that could well be for training rather than combat. The current ground data structure was developed years before deployments became the norm, thus no mishap report "tag" was developed on which to easily identify mishaps occurring at deployed locations or in specific operations. To add to the difficulty of the analysis, the identity of many of the locations/countries in which mishaps occur is classified, but not all classified locations are necessarily those countries where OIF and OEF support operations are staged. Despite this dilemma, we made the broad assumption that all "classified location" reports were from OEF/OIF since we estimate that 95 percent of those are from those operations. Additionally, many reports do list a country of occurrence; we included those SWA countries in which US military forces are based to support either OEF or OIF. Safety data do not include mishaps/injuries sustained under

hostile fire or combat, as DoDI 6055.7 excludes those events from reporting requirements. We included all mishap classes, A through C.
We classified the specific injury mechanism (cause and circumstances--how the injury was sustained) by using both coded and uncoded (narrative text) data. We used conventional International Classification of Diseases revision 10 (ICD-10) and Occupational Safety and Health Administration (OSHA) taxonomies to classify the mishaps in a way that conveys prevention information. No distinction was made by duty status (on vs off), as in the deployed environment, this dichotomy is obviously blurred if not invalid. We excluded civilian employee and contractor injuries. Injury incidence rates could not be calculated since denominator data are not available due to security reasons. Given that data limitation--and also that the low numbers would produce unstable rates--we aggregated all injuries reported in those two years into one cumulative analysis.

Results

A total of 185 injury-generating mishaps were reported during FY02-FY03. Sports and recreation injuries were the most frequently reported by a fairly wide margin. Slips, trips, and falls--a broad category that includes stumbles and feet getting trapped in holes--was the next-most frequent injury mechanism reported. Tied for third place by frequency were motor vehicle related injuries and being struck by, or striking, objects other than motor vehicles. These four mechanisms, or activities, comprised nearly 85% of all mishaps reported.

Injury Mechanism/ Activity	Injury Frequency			
	Fatal	Disabling	Lost time*	**Total**
Sports & recreation	0	0	63	63 (34%)
Slips, trips, & falls	0	0	40	40 (22%)
Struck/struck by object	1	3	30	34 (18%)
Motor vehicle related	2	1	15	18 (10%)
Thermal energy/burn	0	0	7	7 (4%)
Power tools/equipment	0	0	6	6 (3%)
Weapons handling	0	1	3	4 (2%)
Overexertion/force	0	0	4	4 (2%)
Electrical work	0	0	3	3 (2%)
Object dropped on person	0	2	1	3 (2%)
Use hand tool	0	0	2	2 (1%)
Chemical use	0	0	1	1 (<1%)
Total	3 (2%)	7 (3%)	175 (93%)	185 (100%)

* Lost time injuries includes 1 "treated and released" patient injured in a Class A mishap

Airmen-victims injured in, or by, motor vehicles include not only vehicle passengers and operators, but also pedestrians/bystanders who were struck by vehicles. These injuries were the most severe as would be expected. Three of the 18 injuries were either fatalities or disabilities. Note that the data being discussed pertain to injuries, not mishaps per se, and a 1:1 relationship does not exist. For example, the three Class A motor vehicle mishaps embedded in the above table produced six injuries (2 fatalities, 0 disabilities, 3 lost workday injuries, and 1 medically treated and released). The mishap class (e.g., A, B, or C) is based on the most severe injury incurred by an Air Force member involved in a specific mishap. But, less severe injuries occurring in that same mishap are still associated with that mishap and its class.

Specific Injury Mechanisms

Sports and Recreation Injuries

The sports and recreation (S&R) category produced one-third (63 of 185) of total mishaps, but only 17% (336 of 1960) of total days, suggesting that the severity was lower than that of mishaps in other categories. Among S&R, basketball dominated the picture producing the greatest number of mishaps 31 (49%) and lost days 177(53%), an even higher percent than it produces in the USAF overall. This clearly makes basketball a high value target, since eliminating the lost days from this one activity alone would meet the SECDEF 50% reduction goal within the S&R injury arena. Furthermore, basketball alone produces more injuries than 9 of the *non*-S&R activities, 31 of 185 (16%). Since many other activities are a mixture of related but discrete tasks (processes), basketball arguably caused more lost workdays than any other specific activity, 177 of 1960 (9%). The prevention of basketball mishaps is very

	Injuries	% S&R	days lost	% S&R	lost days per inj
Basketball	31	49%	177	53%	5.7
Football	8	13%	34	10%	4.3
Softball	5	8%	22	7%	4.4
Weight lifting	6	10%	23	7%	3.8
Volleyball	5	8%	22	9%	4.4
Running/PT	3	5%	17	5%	5.7
Soccer	2	3%	24	7%	12.0
Wrestling	1	2%	2	1%	2.0
Rafting	1	2%	1	1%	1.0
Bicycling	1	2%	14	4%	14.0
Total	63		336		5.3

difficult due to the inherent need for speed and elevation in playing the game. This is evident in the roughly 60% of the injuries which occur upon landing with the resultant fractures and sprains. The widespread use of ankle supports may be a solution to this problem. The remaining injuries occur from running, cutting and pivoting, and may be reduced by enforcing adequate warm-up prior to playing, and discontinuing stretching.

Basketball breakout	Injuries	% Bball	days lost	% Bball	lost days per inj
Jumping, landed wrong	9	29%	100	56%	11.1
Jump/landed on foot*	9	29%	24	14%	2.7
Running, pivoting, cutting	8	26%	28	16%	3.5
Fell on court	2	6%	19	11%	9.5
Struck by another player	2	6%	3	2%	1.5

* Player A jumped, landed on Player B's foot

Flag football and softball come in a distant second and third place in producing S&R injuries. Collision with another player is the number one cause of football injury, and may be reduced through rule changes (no blocking, etc.). Surprisingly, being hit by the ball is the second leading cause; balls may need to be deflated to reduce the pressure and hardness. Warming up rather than stretching may also prevent some of the other miscellaneous football injuries.

Football Breakout	Injuries	% FB	days lost	% FB	lost days per inj
Hit by ball (catching)	2	25%	4	12%	2.0
Collision with player	2	25%	14	41%	7.0
Twist, bend, reach	1	13%	1	3%	1.0
Finger caught in jersey	1	13%	5	15%	5.0
Planting foot/cutting	1	13%	7	21%	7.0
Running	1	13%	3	9%	3.0

Another surprise is that the number one cause of softball injuries is swinging the bat. Further research needs to be done here, but possibilities include participants being new to softball or excessive playing due to a lack of other available activities. Warming up rather than stretching should be helpful with these injuries, as with every other physical activity.

Softball Breakout	Injuries	% SB	days lost	% SB	Lost days per inj
Swinging	3	60%	22	85%	7.3
Fall	1	20%	3	12%	3.0
Hit by ball	1	20%	1	4%	1.0

Weightlifting mishaps were mainly (4 of 6) strains, which suggests over-lifting. Potential underlying reasons may include inexperience, lack of available alternatives, lack of proper training and oversight, and anxiety.

The remaining activities such as volleyball and soccer had few mishaps which varied so much that it was not possible to group into cause categories.

Injuries due to slips, trips, and falls

The second leading mechanism for injuries during deployment was slips, trips, and falls (n = 40). This category also includes injuries caused by feet or ankles being trapped in surface/ground holes or openings. It does not include STFs that occurred while participating in a sport, a situation in which STFs are quasi-intentional or at least expected. Fortunately, the severity of these high frequency injuries--measured indirectly by the number of lost duty days--was low: an average of 6 lost days per injury (median value was 2 days) vs 15 lost days (median = 4) for non-STF injuries. However, the apparent severity was not uniform over all functional areas. Security Forces reported 8 STF injuries, averaging 1.5 days per injury (median = 1.5 days as well). Supply/POL Storage Yard--where most of the uneven/unstable surface STFs occurred (see chart below)--averaged 2.2 lost duty days for their 5 injuries (median = 2 days). Aircraft maintenance experienced 4 falls which averaged 6 lost duty days (median = 3 days).* One caveat in using lost duty days as a measure of severity: current DoD medical doctrine provides for a small footprint in deployed locations with rapid, routine aeromedical evacuation for injured personnel, many of which would have been treated in-theater in past wars. The length of time away from the deployed duty station depends to some degree on the administrative and logistical processes inherent to personnel movement (clearances, creating manifests, transportation back, etc). Assuming that longer durations of lost duty days indicate higher severity injuries may not always be valid.

Nearly one-third of STF related injuries were due to uneven or unstable surfaces, most notably in fuel dikes and bladders in which plastic coverings overlay and conceal uneven surfaces, or those coverings are themselves slick. Next in

* Both means (averages) and medians are presented due to the skewness of the data; means are sensitive to extreme values, medians are not.

reported frequency were STFs which were associated with performing tasks requiring or involving military special-purpose vehicles (e.g., refueling, refilling, attaching/detaching equipment, "bobtails" (a multi-purpose hitch) in particular).

Injury Mechanisms - Frequencies

From/to/due to [object below]	Fall, one level to another	Fall, same level--trip, slip, stumble	Trap/twist foot/ankle	Jump	Freq Total	Major risk areas
Uneven/unstable surface (from/on)	2	6	5	0	13	Fuel dikes & bladders (plastic liners hide uneven/ unstable surfaces); austere conditions; no night lighting (force protection)
Vehicle (from)	4	0	1	1	6	Filling special purpose vehicles (with fuel or water); working with bobtails; frequent high winds
Cable (on)	0	3	0	0	3	2 of 3 were power cables on ground; other was strung at height of 24"
Furniture (from)*	3	0	0	0	3	"Household tasks" such as changing light bulb, silencing smoke alarm
Ladder/stairs, stands (from/on)	2	0	1	0	3	2 of 3 on aircraft servicing stands; 2 of 3 involved refueling tasks
Aircraft ladders/ stairs (from)	2	0	0	1	3	2 of 3 climbing up or down; 1 jumped from top of ladder onto ground
Matting (on)	0	2	0	0	2	Both occurred while entering/exiting over a threshold--matting not seen
Release of force (due to)	0	2	0	0	2	1 caused by a range safety violation when grenade detonated during training
Tower (from)	2	0	0	0	2	Both were falls through open doors or hatches
Ramp (on)	0	1	0	0	1	Inattention
Manhole (into)	1	0	0	0	1	Night ops; no lighting; no NVG-compatible flashlight; no covering
Wet floor (due to/on)	0	0	1	0	1	Frisky military working dog
Total	16	15	7	2	40	

* Includes chairs, stool, and beds

Injuries related to motor vehicles

One-half of the 18 injuries in this category were associated with special purpose military vehicles. Eight occurred in "conventional" military/ government motor vehicles (GMVs), and one person received a disabling injury while riding a bicycle. Seven airmen were injured in single-vehicle incidents in which no collision occurred, almost always in a special purpose vehicle including ATVs. Three were injured in collisions involving multiple GMVs. Another three were injured in collisions or avoidance situations with civilian private motor vehicles. A greater proportion of deployed motor vehicle related injuries occur in single-vehicle mishaps as a result of the underdeveloped or damaged roadway engineering. And, many deployment mishaps occur while avoiding vehicles being driven recklessly in an overwhelmingly chaotic environment. Outside the area of true motor vehicles, forklifts injure more airmen during deployments than in normal operations. This is an area which deserves more attention.

Other injury mechanisms

Other than forklifts in the struck/struck by category, the remaining injuries did not cluster within a mechanism sub-category or object. Data for these injuries are presented below along with additional information on the role of airmen injured in vehicular mishaps.

Mechanism category	Mechanism sub-category (Role, object, or activity)	Total
Struck/Struck By Object/ Contact with	Forklift	7
	Rotary Launcher	3
	Entry Gate Arm/Barrier	3
	Tow Bar	2
	Tailgate	3
	Pallet	2
	Falling Object	2
	Other Person	2
	Generator	2
Object struck, or object struck by --→	Truck Bed	1
	Ground	1
	Fan	1
	Pole	1
	Aircraft Antenna	1
	Door	1
	Excavator	1
	Engine Part	1
Struck/Struck By Object, Total		34

Mechanism category	Mechanism sub-category (Role, object, or activity)	Total
Motor Vehicle/PMV	Operator (1 bicyclist incl)	8
Injured person's role in mishap -→	Passenger	8
	Worker	1
Motor Vehicle, Total		17
Thermal Energy/Burn	Water	1
	Aerosol Can	1
	Coffee	1
Object or substance -→	Gravy	1
	Pitot Tube	1
	Soup	1
	Trash	1
Thermal Energy/Burn, Total		7
Power Tools/Equipment	Nail Gun	2
	Welding	1
Specific tool being used -→	Metal Shearing Machine	1
	Circular Saw	1
	Skill Saw	1
Power Tools/Equipment Total		6
Weapons Handling	Small Arms	3
Type of weapon/ordinance -→	Ordinance	1
Weapons Handling, Total		4
Exertion/Force	Push	2
Type of force or direction -→	Lift	1
	Pull	1
Exertion/Force, Total		4
Electrical Work	Live Circuit	3
Electrical Work, Total		3
Dropped Object	Sewer Pipes	1
Specific object dropped -→	Jersey Barrier	1
	Knife	1
Dropped Object, Total		3
Hand Tool	Sledgehammer	1
Specific tool used -→	Knife	1
Hand Tool Total		2
Chemical Burn	Activity: Acft Maintenance	1
Chemical Burn, Total		1

Summary

Injury-producing mechanisms associated with deployed combat support operations resemble those of the non-deployed setting. (Readers are encouraged to compare findings in this report to our *Descriptive Epidemiology of Lost Workday Injuries, Part II: Detailed Analysis* which may be downloaded at http://afsafety.af.mil). The main exception to this pattern is with injuries due to motor vehicles. In "non-deployed" Air Force life this problem is overwhelmingly a personal motor vehicle phenomenon. During deployment operations airmen drive military-owned, combat or special purpose vehicles, not passenger cars. While motor vehicle related injuries may not ascend to the top of the deployment injury frequency listing, driving and riding in vehicles remains a major safety threat.

Slips, trips, and falls are near the top of the injury-producer listing in both deployed and non-deployed situations. However, the profiles of these two situations differ significantly in their specific mechanisms (again, comparing against the "Part II" analysis). Gone (literally) from the deployed setting are the STFs from ice/snow, wet floors, and roadside curbs which plague the non-deployed setting. Instead, the STF pattern during OEF/OIF has largely been associated with uneven surfaces and performing tasks on, or with, special purpose vehicles and equipment. Also of concern are the areas around fuel depots where dikes and fuel bladders represent a particularly unsafe surface on which to walk.

The mass of injuries associated with military vehicles, forklifts, and vehicle-associated STFs presents a strong argument for more consistent application of ORM in situations involving motor vehicles/wheeled equipment. In some cases, it was clear that ORM had indeed been applied. Many STFs at night could have been prevented by using flashlights or flares; however, taking those preventive measures would certainly have increased the risk of a far more severe injury, or death, due to hostile fire. Narratives indicated that airmen were purposefully not supplied with flashlights or portable lighting rather than the supply/issue system having failed. In situations where that trade-off appears on face to have been favorable to airmen, leaders should have ensured that known safety hazards such as uncovered manholes were at least barricaded to preclude entry--a more in-depth ORM to prevent an equally catastrophic event. Unintended consequences should always be part of the ORM equation.

Sports and recreation mishaps, an important producer of injury in the non-deployed setting, become even more important in the deployed setting. This is probably due to deployed airman increasing their participation to fill free time when separated from family and normal routines. Since basketball dominates the injury picture, a significant reduction in injury cannot be achieved without addressing this problem. Difficult decisions must be made to minimize injury during this critical time of deployment, and interventions may include redirecting participation from basketball to lower risk sports.

SEPR will continue to monitor data from deployed locations for meaningful trends that provide mishap prevention clues. Further research will be improved by both an increased level of mishap reporting and finer detail in those reports. We will report important findings to the DOTF.

BRUCE COPLEY, PhD, MPH
Lt Col, USAF, BSC
Chief, Research and Epidemiology Branch
Plans and Programs Division
HQ, Air Force Safety Center
Kirtland AFB, New Mexico